Remarks

Reconsideration and reexamination of the above-identified patent application, as amended, are respectfully requested. Claims 1-3, 6-7, 9-13, and 16-20 are pending in this application upon entry of this Amendment. In this Amendment, the Applicant has amended claims 1, 3, 11, and 13; cancelled claims 4-5 and 14-15; and added claim 20. Of the pending claims, claims 1, 11, and 20 are the only independent claims.

Claim Rejections - 35 U.S.C. § 103

In the Office Action mailed July 30, 2004, the Examiner rejected claims 1-4, 6, 11-14, and 16 (which include independent claims 1 and 11) under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,977,732 issued to Matsumoto ("Matsumoto") in view of U.S. Patent No. 4,924,166 issued to Roussel ("Roussel") and further in view of U.S. Patent No. 4,583,190 issued to Salb ("Salb"). The Applicant believes that the claimed invention is patentable over any combination of Matsumoto, Roussel, and Salb and has amended independent claims 1 and 11 and written new independent claim 20 to more clearly define thereover.

1. The Claimed Invention

The claimed invention as recited in amended independent claims 1 and 11 and new independent claim 20 is directed to a method for determining the frequency of current ripples contained in the armature current signal of a commutated DC motor.

As recited in amended independent claim 1, the method includes determining a frequency spectral result of the armature current signal of the motor in which the armature current signal contains current ripples and interference; and determining a frequency spectral result of a voltage signal of the motor in which the motor voltage signal contains the interference. A frequency spectral result of the current ripples contained in the armature

current signal is then determined based on differences between the frequency spectral result of the armature current signal and the frequency spectral result of the motor voltage signal such that the determined frequency spectral result of the current ripples contained in the armature current signal is void of frequency components which are superimposed on the armature current signal as the interference. The frequency of the current ripples contained in the armature current signal is then determined from the determined frequency spectral result of the current ripples contained in the armature current signal.

As recited in amended independent claim 11, the method is generally similar to the method recited in amended independent claim 1, but further recites that the frequency spectral result of the current ripples contained in the armature current signal is determined based on differences between the frequency spectral results of the armature current signal and the motor voltage signal without filtering any of the frequency spectral results of the armature current signal and the motor voltage signal.

2. Matsumoto, Roussel, and Salb

A. Matsumoto

The Examiner cited Matsumoto for disclosing a method for determining the frequency of current ripples contained in the analog armature current signal of a DC motor (citing col. 6, lines 31-32 and 60) comprising

determining an armature current signal (citing col. 6, lines 34-37; col. 7, lines 20-21),

determining an electric operating parameter of the motor (citing col. 6, lines 34-37; col. 7, lines 18-19),

determining a result of the current ripples contained in the armature current signal based on the armature current signal and the motor electric operating parameter, and

determining current ripple frequency from the current ripples contained in the armature current signal, without filtering (citing col. 7, lines 18-21).

As such, the Examiner posited that Matsumoto teaches a ripple detector that determines a current ripple frequency based on both an armature current signal and an armature voltage signal, but does not explicitly state that the ripple detector determines the current ripple frequency based on differences between the current and voltage signals.

B. Roussel

The Examiner posited that Roussel discloses a method for determining the frequency of current ripples contained in the armature current signal of a DC motor (citing col. 1, lines 9-13, comprising

determining an armature current signal,

determining an electric operating parameter of the motor (i.e., the signal taken across the terminals of a shunt) (the motor electric operating parameter is an armature current signal (citing col. 4, lines 48-53)),

subtracting the armature current signal and the motor electric operating parameter from one another to determine the current ripples contained in the armature current signal (citing col. 5, lines 28-33), and

determining a current ripple frequency from the current ripples contained in the armature current signal (citing col. 2, lines 43-50).

The Examiner posited that it would have been obvious to modify Matsumoto to state that the ripple detector determines the current ripple frequency based on differences between the current and voltage signals at taught by Roussel, because Matsumoto does disclose determining current ripple frequency based on both armature current and voltage signals, but does not give a corresponding relationship and Roussel suggests such a relationship for determining the current ripple frequency.

The Examiner indicated that the combination of Matsumoto and Roussel does not specifically determine a frequency spectral result of these current and voltage signals through digitization and a fast Fourier transform (FFT).

C. Salb

The Examiner posited that Salb teaches a micro-computer based system for performing FFTs wherein the analog signals being analyzed are first digitized at each point in time and then analyzed using a FFT to obtain an unfiltered frequency spectral result (citing col. 7, lines 46-48).

The Examiner posited that it would have been obvious to modify Matsumoto and Roussel to include determining a frequency spectral result of these current and voltage signals through digitization and a FFT, as taught by Salb, because this method for frequency analysis is well-known in the art to provide the user with easier mathematical analysis due to the signals being better defined in classical mathematical signal processing terms (citing col. 7, lines 28-34).

4. Analysis of Roussel

As indicated above, the Examiner posited that Roussel discloses subtracting the armature current signal and the motor electric operating parameter from one another to determine the current ripples contained in the armature current signal (citing col. 5, lines 28-33) and that the motor electric operating parameter is an armature voltage signal (citing col. 4, lines 48-53).

Col. 5, lines 28-33 of Roussel recites [with the Applicant's comments in brackets]:

The subtractor stage 210 serves to subtract the mean component of the armature current as delivered by the follower amplifier stage 320 from the signal taken across the terminals of the shut [this signal is defined on col. 4, lines 48-53; also see col. 3, lines 45-49]. As a result, the signal delivered by the subtractor stage 210 represents the periodic components of the armature current [i.e., represents the current ripples contained in the armature current].

5. The Claimed Invention Compared to Matsumoto, Roussel, and Salb

The claimed invention generally differs from any combination of Matsumoto, Roussel, and Salb in that the claimed invention determines a frequency spectral result of the current ripples contained in the armature current signal based on differences between (1) the frequency spectral result of the armature current signal which contains the current ripples and interference and (2) the frequency spectral result of the motor voltage signal which contains the interference such that the determined frequency spectral result of the current ripples contained in the armature current signal is void of frequency components which are superimposed on the armature current signal as the interference, whereby the frequency of the current ripples contained in the armature current signal is determinable from the determined frequency spectral result of the current ripples contained in the armature current signal.

That is, the claimed invention determines [a frequency spectral result of] the current ripples based on differences between (1) [the frequency spectral result of] the armature current signal which contains the current ripples and interference and (2) [the frequency spectral result of] the motor voltage signal which contains the interference. In effect, the claimed invention is in accord with the following equation: current ripples + interference - interference = current ripples.

In contrast, Roussel determines the current ripples by subtracting the mean component of the armature current signal from the armature current signal [i.e., the voltage signal taken across the terminals of a shunt resistance connected in series with the motor armature (see col. 5, lines 28-33; and col. 4, lines 50-53) is "directly proportional to the armature current of the D.C. motor" as recited in col. 3, lines 45-49]. In effect, Roussel is in accord with the following equation: mean armature current signal - armature current signal = current ripples.

Further, the Examiner's motivation for modifying Matsumoto and Roussel with Salb was that frequency analysis provides more accurate analysis due to the signals being better defined in the classical mathematical signal processing terms (citing col. 7, lines 28-34 of Salb). However, Salb notes that the disadvantage in using frequency analysis include "the much more intensive computation necessary as compared to time domain techniques." (See col. 7, lines 34-36 of Salb.). As such, it may not necessarily be evident to one skilled in the art to use frequency analysis instead of time analysis in those applications which could be properly used with either analysis.

Further, the Applicant believes that a skilled person arriving at the idea of using frequency spectra results to determine current ripples as provided by the claimed invention would thereafter turn to Salb in order to reduce the invention to practice, but only after having conceived the invention in its entirety.

Therefore, the Applicant believes that modifying Matsumoto, Roussel, and Salb in the manner set forth by the Examiner would not result in the claimed invention as set forth in amended independent claims 1 and 11. Accordingly, the Applicant believes that amended independent claims 1 and 11 is patentable under 35 U.S.C. § 103(a) over Matsumoto in view of Roussel and further in view of Salb. Claims 2-3, 6, and 12-13 depend from one of amended independent claims 1 and 11 and include the limitations therein. Thus, the Applicant requests reconsideration and withdrawal of the rejection to claims 1-3, 6, and 11-13 under 35 U.S.C. § 103(a).

The Examiner rejected claims 5 and 15 under 35 U.S.C. § 103(a) as being unpatentable over Matsumoto in view of Roussel and Salb and further in view of U.S. Patent No. 5,359,275 issued to Edwards ("Edwards"). Claims 5 and 15 have been cancelled.

The Examiner rejected claims 7, 9-10, and 17-19 under 35 U.S.C. § 103(a) as being unpatentable over Matsumoto in view of Roussel and Salb and further in view of U.S. Patent No. 4,952,854 issued to Periou et al. ("Periou"). Claims 7, 9-10, and 17-19 depend

from one of amended independent claims 1 and 11 and include the limitations therein. As such, the Applicant respectfully requests reconsideration and withdrawal of the rejection to claims 7, 9-10, and 17-19 under 35 U.S.C. § 103(a).

CONCLUSION

In summary, claims 1-3, 6-7, 9-13, and 16-20, as amended, meet the substantive requirements for patentability. The case is in appropriate condition for allowance. Accordingly, such action is respectfully requested.

If a telephone or video conference would expedite allowance or resolve any further questions, such a conference is invited at the convenience of the Examiner.

Respectfully submitted,

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